ETHYLENE DIBROMIDE

Identified as a toxic air contaminant under California's air toxics program (AB 1807) in 1992.

CAS Registry Number: 106-93-4 CH_2BrCH_2Br

Molecular Formula: $C_2H_4Br_2$

Ethylene dibromide is a volatile, colorless, heavy liquid with a mild, sweet chloroform-like odor (Merck, 1989). Because of its vapor pressure of 11.2 millimeters (mm) of mercury at 25 °C, ethylene dibromide will occur in the vapor-phase in the ambient atmosphere. Liquid ethylene dibromide will attack some forms of plastics, rubber, and coatings. It is slightly soluble in water and soluble in alcohol, ether, acetate and benzene and is miscible with most organic solvents (HSDB, 1995). Ethylene dibromide is a non-polar, stable compound (ARB, 1985a).

Physical Properties of Ethylene Dibromide

Synonyms: 1,2-dibromoethane; ethylene bromide; 1,2-ethylene dibromide; glycol bromide; Dowfume; Pestmaster; EDB-85; Soilbrom; Bromofume

Molecular Weight:	187.88
Boiling Point:	131 - 132 °C
Melting Point:	9.8 °C
Vapor Pressure:	11.0 mm Hg at 25 °C
Density/Specific Gravity:	2.172 at 25/25 °C
Log Octanol/Water Partition Coefficient:	86 at 11.0 mm Hg at 25 °C
Vapor Density:	6.5 (air = 1)
Conversion Factor:	1 ppm = 7.7 mg/m^3

(HSDB, 1995; Merck, 1989; Sax, 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

In the past, ethylene dibromide was used as a fumigant in soil and on grain, fruits, and vegetables and as a lead scavenger in leaded gasoline. Its pesticidal use as a fumigant in soil and grain was banned by the United States Environmental Protection Agency (U.S. EPA) in 1984 (ATSDR, 1992a), and as of January 1, 1987, ethylene dibromide is no longer registered for pesticidal use in California (DPR, 1996). As leaded gasoline is phased out, ethylene dibromide is no longer important as a fuel additive. Ethylene dibromide is also used as a solvent for resins,

gums, waxes, and as a chemical intermediate in the manufacture of dyes, pharmaceuticals and other organic compounds (ARB, 1985a).

The primary stationary sources that have reported emissions of ethylene dibromide in California are airports/flying fields and services, hydraulic cement manufacturers, and petroleum refining (ARB, 1997b).

B. Emissions

The total emissions of ethylene dibromide from stationary sources in California are estimated to be at least 8,200 pounds per year, based on data reported under the Air Toxics "Hot Spots" Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

Ethylene dibromide may be formed naturally in the ocean as a result of macro algae growth (HSDB, 1995).

AMBIENT CONCENTRATIONS

Ethylene dibromide has been routinely monitored by the statewide Air Resources Board (ARB) toxics monitoring network. When ethylene dibromide was formally identified in 1985 as a toxic air contaminant, the ARB estimated an annual concentration of 0.077 micrograms per cubic meter ($\mu g/m^3$) or 0.010 parts per billion (ppb) (ARB, 1985a). Concentrations of ethylene dibromide during a 12 month period from July 1993 through June 1994 range from <0.08 to 0.08 $\mu g/m^3$ (<0.01 to 0.01 ppb). The overall mean statewide exposure is estimated to be 0.038 $\mu g/m^3$ (0.005 ppb) (ARB, 1995b).

The U.S. EPA has also reported concentrations of ethylene dibromide from 64 study areas during 1976 to 1987. Overall range of concentrations from these areas were from 0.0 to 231 $\mu g/m^3$ (0.0 to 30.0 ppb) with an overall mean concentration of 1.80 $\mu g/m^3$ (0.23 ppb) (U.S. EPA, 1993a).

INDOOR SOURCES AND CONCENTRATIONS

Data on indoor concentrations of ethylene dibromide are extremely limited. During June of 1990, 125 households in Woodland, California were monitored for a variety of toxic air contaminants (Sheldon et al., 1992). Sampling included ethylene dibromide; however, it was not present in measurable concentrations in any of the samples. The method quantifiable limit was 0.15 $\mu g/m^3$.

A southern California in-vehicle study measured a mean ethylene dibromide concentration

of 0.11 $\mu g/m^3$ and a maximum concentration of 1.13 $\mu g/m^3$ during the summer of 1987 and winter of 1988 (Shikiya et al., 1989). However, since leaded gasoline has been banned in California since January 1992 and the rest of the United States since January 1996, in-vehicle concentrations of ethylene dibromide are expected to be similar to that of the ambient air.

ATMOSPHERIC PERSISTENCE

The dominant tropospheric loss process of ethylene dibromide is expected to be by gas-phase reaction with the hydroxyl radical. The calculated half-life for the gas-phase reaction with the hydroxyl radical is estimated to be about 40 days. Thus, ethylene dibromide is a persistent pollutant that can be transported long distances and is apt to be present throughout an urban air shed (ARB, 1985a). Ethylene dibromide has been found in groundwater and when spilled in water, will be removed by evaporation with a half-life of 1 to 5 days (HSDB, 1995).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics "Hot Spots" Program (AB 2588). Of the risk assessments reviewed as of April 1996, ethylene dibromide was the major contributor to the overall cancer risk in 1 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million and contributed to the total cancer risk in 46 of the these risk assessments. Ethylene dibromide also was the major contributor to the overall cancer risk in 1 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million, and contributed to the total cancer risk in 12 of these risk assessments (OEHHA, 1996a).

For non-cancer health effects, ethylene dibromide contributed to the total hazard index in 6 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1 (OEHHA, 1996b).

HEALTH EFFECTS

Probable route of human exposure to ethylene dibromide is inhalation.

Non-Cancer: Ethylene dibromide is a respiratory tract, eye and skin irritant and is capable of causing severe chemical burns and blistering at high exposures. Inhalation of ethylene dibromide vapor can produce delayed-onset pulmonary edema and lesions as well as central nervous system effects. Acute exposure can cause weakness, vomiting, diarrhea, chest pain, cough, shortness of breath, cardiac insufficiency, liver and kidney injury, and death (U.S. EPA, 1994a). Prolonged contact with ethylene dibromide by inhalation, ingestion, or skin contact can cause severe testes, liver, and kidney injury (Proctor, et al, 1988; U.S. EPA, 1994a).

A chronic non-cancer Reference Exposure Level (REL) of 4.6 $\mu g/m^3$ is listed for ethylene dibromide in the California Air Pollution Control Officers Association Air Toxics "Hot Spots"

Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoints considered for chronic toxicity are the reproductive and respiratory systems. The U.S. EPA has the Reference Concentration (RfC) under review, and has calculated a provisional RfC of 0.2 $\mu g/m^3$ for ethylene dibromide but has not calculated an oral Reference Dose (RfD). The U.S. EPA estimates that inhalation of the RfC or less, over a lifetime, would not likely result in the occurrence of chronic non-cancer effects.

Limited data on men exposed occupationally to ethylene dibromide indicate that long-term exposure can damage sperm and possibly impair reproduction (U.S. EPA, 1994a). Adverse reproductive effects have been observed in the testes of animals. Bulls that have ingested ethylene dibromide either as adults or during development have been found to have abnormal and decreased numbers of spermatozoa (ATSDR, 1992a). Rats had a decrease in litter size, and rats and mice had skeletal abnormalities and reduced fetal weight when dams were exposed via inhalation to doses that also influenced indices of maternal toxicity (ATSDR, 1992a).

Cancer: Two cancer studies on workers exposed to ethylene dibromide have been carried out. Neither study reported a statistically significant increase in cancer mortality; however, these studies were considered inadequate due to confounding factors (U.S. EPA, 1994a). Animal cancer bioassays by inhalation, oral, and dermal routes have shown in both sexes in more than one animal species ethylene dibromide to be a probable carcinogen. Malignancies were reported both at the site of first contact as well as remote sites such as the circulatory system, lung, and pituitary, among others (ARB, 1985a).

The U.S. EPA has classified ethylene dibromide in Group B2: Probable human carcinogen on the basis of sufficient evidence for carcinogenicity in animals and inadequate evidence in humans, and determined an inhalation unit risk estimate of 2.2×10^{-4} (microgram per cubic meter)$^{-1}$. The U.S. EPA estimates that if an individual were to breathe air containing ethylene dibromide at 0.005 $\mu g/m^3$, over a lifetime, that person would theoretically have no more than a 1 in 1 million increased chance of developing cancer (U.S. EPA, 1994a). The International Agency for Research on Cancer has classified ethylene dibromide in Group 2A: Probable human carcinogen (IARC, 1987a).

The State of California has determined under Proposition 65 that ethylene dibromide is a carcinogen (CCR, 1996). The inhalation potency factor that has been used as a basis for regulatory action in California is 7.1×10^{-5} (microgram per cubic meter)$^{-1}$ (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 $\mu g/m^3$ of ethylene dibromide is estimated to be no greater than 71 in 1 million. The oral potency factor that has been used as a basis for regulatory action in California is 3.6 (milligram per kilogram per day)$^{-1}$ (OEHHA, 1994).